Depression and role functioning

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3.

Longitudinal associations between depressive problems, academic performance, and social functioning during adolescence

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Abstract

Depressive problems and academic performance, social well-being, and social problems in adolescents are strongly associated. However, longitudinal and bidirectional relations between the two remain unclear, as well as the role of gender. Consequently, this study focuses on the relation between depressive problems and three types of functioning in adolescents, while testing gender differences. Depressive problems and functioning of 2230 children was measured with structured questionnaires. The measurements took place biennially over three waves, from late childhood into adolescence (age range 10-18 years). To examine the longitudinal relation between depression and functioning, path analyses with cross-lagged effects were conducted with structural equation modelling. Multi-group analyses were used to test for gender differences, which were only observed for academic performance. Other findings indicated substantial stability in depressive problems and functioning over time and within-wave correlations between depression and the three types of functioning. Poor social well-being was predicted by depressive problems but not the other way around. The relation between depressive and social problems was bidirectional, i.e. they predicted each other. Finally, depressive problems and academic performance were bidirectionally related as well, but only in girls.

Introduction

There is ample evidence of an association between depressive problems and impairments in role functioning (e.g., academic performance, social well-being, and social problems) during adolescence. Previous studies have found that both depression predicts later problems in functioning, and that functional problems predict later depression.[1-7] However, the bidirectional relationship between the two remains unclear. Do in particular depressive problems cause poor functioning, is it the other way around, or are the effects equally strong? It is also unclear whether depressive and functional problems in late childhood carry a risk for similar problems in later adolescence and if this differs between girls and boys. This gap in the current knowledge is due to the fact that many studies that examined the link between depressive problems and functioning were conducted cross-sectionally, unidirectional, or neglected potential gender differences. Nonetheless, information about longitudinal and possible bidirectional relationships between depressive problems and functioning is extremely valuable in assessing whether preventions or interventions should be targeted at depressive or functional problems in the first place. To address this lack of knowledge, we study the relationship between depressive problems and academic performance, self-perceived social well-being, and parent-reported social problems from late childhood into late adolescence. In addition, the role of gender is assessed and reports from multiple informants are taken into account.

Theoretical background

The competency-based model of depression is a model that describes the mechanism underlying the relationship between poor performance in several domains of functioning and depressive problems in adolescence.[8] This model asserts that children who perform poorly in one or more domains of functioning may receive negative feedback from others, which can trigger the risk of depressive problems. According to this theory, children learn to base their self-perception on the way they are regarded by others. If a child is negatively regarded by others, the child may tend to adopt this negative view which results in a negative self-perception. This negative self-perception may increase the risk of depressive problems among these poorly functioning children. In the other direction, the framework of the International Classification of Functioning, Disability and Health (ICF) describes why depressive problems may lead to functional problems.[9] The medical model of the ICF views poor functioning (or disability) as a feature of a person that is directly caused by a disease, for example depression. Consequently, poor functioning of children might be directly caused by the depressive problems the child suffers from.

Longitudinal associations between depressive problems and functioning

Adolescence is a developmental period during which individuals face important social and biological transitions, such as differentiation from parents, creating new friendships, and exploring one's identity,[10] and is typically a period that is critical for the onset and development of depressive problems.[11,12] Previous studies reported significant increases in depressive problems from late childhood through early adolescence, in particular in girls.[13-16] For some adolescents, this increase is a precursor to major depressive disorder into adulthood.[17-19] As asserted by several biopsychosocial models of psychopathology, depressive disorders are heterogeneous conditions that develop through a variety of pathways. These pathways can be influenced by biological (e.g., genetic), psychological (e.g., cognitive), and social contextual (e.g., peer relationship) factors.[20] These factors can have positive, but also negative effects on the development of depressive problems. To illustrate, with regard to social relationships it has been shown that increases in social support are associated with increased psychological well-being and are thus positive.[21] In contrast, adolescents with depressive problems tend to select friends with similar levels of depression, and adolescents with depressed friends showed elevated depressive problems themselves and can thus be negative for the development of depression.[22,23] Furthermore, if the level of depressive problems in two befriended adolescents was dissimilar, friendships seemed to be ended more frequently.[23]

Besides the risk of carrying the depressive problems into adulthood, depressive problems during adolescence can greatly impact role functioning. Several studies examined the relationship between depressive problems and functioning in multiple domains, of which the majority focused on relationships between depressive problems and academic performance. Evidence on the relation between depressive problems and academic performance remains inconclusive, although support seems stronger for a link from academic performance to depressive problems than the other way around. More specifically, several studies found that a high level of academic performance, such as high grades, protects against depressive problems.[4,6,24] In the opposite direction, some other cross-sectional studies found that depressive problems were associated with poor academic performance.[1,4] However, longitudinal studies found no support for this association to hold over time.[2,6,25] Moilanen and colleagues[6] concluded that it may be possible that emotional problems have a small impact on academic performance, but that these small effects do not emerge when longitudinal stability in academic performance is controlled for. Based on the aforementioned evidence and theory, we expect that poor academic performance leads to more depressive problems. Poor academic performance is a relatively objective measure based on school results and consequently leaves small room for free interpretation of whether the functioning is good or poor. Therefore, poor academic performance is likely to lead to negative feedback from parents, classmates, teachers, and others. As described by the competency-based model of depression, this negative feedback may initiate negative self-perception of the adolescent, which can subsequently trigger depressive problems. Alternatively, the ICF model suggests

a negative effect of depressive problems on academic performance. However, evidence for this association is weak and we therefore expect that the effect of depressive problems on poor academic performance to be small or absent.

Moreover, previous studies found associations between depressive problems and functioning in the social domain, in particular with respect to perceived social well-being and actual social problems. Poor social well-being, such as negative perceptions of the relationships with peers at school, has been cross-sectionally associated to depressive problems,[7] but there was no support for a longitudinal relationship between social well-being and depressive problems.[5] As these studies are inconclusive, we need to test whether poor social well-being carries a risk for later depressive problems. Other studies indicated that depressive problems negatively impact social well-being, perhaps due to negative feedback seeking of adolescents with depressive cognitions.[26,27] In line with previous research, we thus hypothesise that depressive problems decrease social well-being, whereas social well-being may not necessarily influence depressive problems over time. The first part of this hypothesis is in line with the ICF model, which asserts that depressive problems may directly influence functioning, such as social well-being. Support for a prospective effect of poor social well-being on depressive problems is, as described above, weak and the competency-based model of depression may not directly be applicable to the social well-being measure. That is, the competency-based model of depression departs from the perspective that social functioning would be evaluated negatively by other people, whereas social well-being assesses how social functioning is interpreted by the adolescent him- or herself. These two views do not always have to align, particularly when depressive thoughts bias the adolescent's self-perception.

Previous studies on the relationship between depressive and social problems were mainly unidirectional and focused on the predictive value of social problems on depressive problems. Social problems include problems in the social relations with others (peers, adults; e.g., being shy or independent) and motor difficulties that are associated with poor social functioning (e.g., being clumsy, speech problems). Some studies showed that social problems were associated with depressive problems,[7,28,29] whereas others found no such association.[5,30] Longitudinally, Rose and colleagues[3] studied the effect of depressive symptoms on social functioning and found that depressive problems predicted social problems such as having fewer friends, lower positive friendship quality concurrently and over time, as well as lower friendship stability. However, Cole[31] found that depression did not predict social competence at later age. In addition, Vernberg[29] described a vicious cycle between depressive problems and poor social functioning in which poor social experiences lead to increases in depressive affect, while greater depressive affect increased the likelihood of poor social functioning. Overall, it seems that social problems and depressive problems predict each other over time, thus we expect to find a longitudinal bidirectional relationship between the two. This is in line with both the ICF model and the competency-based model of depression. Social problems may be a direct result of depressive problems, as described

by the ICF model. Furthermore, is seems plausible to explain the effect of social problems on depressive problems via the competency-based model. As earlier described, this model assumes that functioning is based on the evaluation by others. Our parent-reported social problems measure nicely reflects this observation by others. Thus, in line with the competency-based model of depression, it is likely that parent-reported social problems are associated with more depressive problems over time.

Gender differences in the longitudinal association between depressive symptoms and functioning

Some studies reported gender differences in the previously described relations between depressive problems and problems in various domains of functioning. However, this resulted in inconsistent conclusions. Derdikman-Eiron and colleagues[1] found that the associations between depressive problems and lower academic performance were larger among boys than among girls. In contrast, multiple studies found that depression-associated functional impairment was higher in girls than in boys. Undheim et al.[5] found that baseline grades predicted later depression in girls but not in boys, and that girls showed significantly lower social well-being in class than boys. Nagar et al [32] showed that general impairment (i.e., academic and social performance) was higher in girls than in boys. In addition, it has been studied that women are more sensitive to social problems than males.[33] For our study, this would imply that the effect of poor social well-being and more social problems on depression is stronger in girls than in boys. Taken together, evidence suggests gender differences in the relation between depressive problems and functioning with stronger bidirectional associations between depressive problems and functioning in girls.

The present study

When summarising the aforementioned research, is it clear that there is an association between depressive problems and functioning in various domains. However, longitudinal cross-lagged analyses that examined the strength and direction of the associations between the two are scarce and the available evidence is contradictory. Also, only few studies assessed bidirectional relationships within the same sample and not all studies took possible gender differences into account. Therefore, it is hard to draw conclusions on the existence, strength, and direction of the relationship between depressive and functional problems, and on gender differences. This emphasises the need for additional research on the longitudinal relations between depressive and functional problems from late childhood into early adolescence. Accordingly, the present study describes the longitudinal and bidirectional relationship between depressive problems and academic performance, social well-being, and social problems of adolescents, tested across gender.

This study has several aims. First, we aim to examine whether a relation between depressive symptoms and the particular type of functioning exists, and study the relationship of these variables over time. Second, we aim to assess whether longitudinal associations between depressive problems and problems in the three domains of functioning differ between boys and girls. Furthermore, we aim to take into account different informants of psychopathology. As was shown in our previous study,[27] findings with regard to the association between depressive problems and functioning differ considerably depending on the informant of the variables under study, hence we combined reports from child and parent to create an adequate measure of depressive problems.

To conclude, we expect substantial consistency of both depression and functioning across time.[30,34,35] In addition, we expect cross-lagged effects from depression on later functioning in all domains and from functioning in all domains on later depression, though varying in strength between the different measures of functioning. Based on our theoretical framework, particularly measures of functioning that are reported by others or are susceptible to criticism by others are likely to increase depressive problems. We thus expect academic performance to influence later depressive problems whereas the reverse relation will be absent or weak; depressive problems to influence later social well-being, whereas the effect of social well-being on depressive problems should be explored; and a bidirectional relationship between depressive problems and social problems.[1-7,24,26,27,29,36] Gender differences are likely to occur, with stronger relationships between depressive problems and functioning in girls.[5,32]

Method

Study population

This study was part of the TRacking Adolescents' Individual Lives Survey (TRAILS), a prospective cohort study of Dutch preadolescents who will be measured biennially until they are at least 25 years old. The present study involved the first (T1; 2001-2002), second (T2; 2003-2004) and third (T3; 2005-2007) assessment waves of TRAILS. The TRAILS target sample consisted of preadolescents living in five municipalities in the northern part of the Netherlands, including both urban and rural areas. Of all individuals who were asked to participate in TRAILS (N=2935), 76.0% agreed to participate in the first assessment wave (N=2230; mean age 11.09 years; SD 0.55; 50.8% girls). At the second assessment wave, 96.4% of these participants (N=2149) were re-assessed, while T3 was completed with 81.4% of the original number of participants (N= 1816; mean age 16.27 years; SD 0.73; 52.3% girls). A detailed description of the study design, sampling procedures, data collection, and measures of the TRAILS study can be found in De Winter et al.[37] and Huisman et al.[38].

Measures

Depressive problems

Because no informant is inherently superiour to another in identifying depressive problems, we combed the mean of the scores on depressive problems provided by child and parent (Spearman's rho=0.28-0.39). As such, we took into account the unique views of these two important informants. If one report was missing, we used the score of the available informant. Child-reported depressive problems were assessed with the Youth Self-Report (YSR). This is one of the most commonly used questionnaires in child and adolescent psychiatric research[39] and contains a list of 112 behavioural and emotional problems, which children can rate as 0 = not true, 1 = somewhat or sometimes true, or 2 = very or often true in the past six months (13 items; T1=α 0.77; T2=α 0.72; T3=α 0.78). The parent-reported version of this questionnaire, the Child Behavior Checklist (CBCL; 13 items; T1=α 0.68; T2=α 0.73; T3=α 0.76), was used to administer parent-reported depressive problems.[40,41] The original YSR and CBCL scales cover multiple scales of behavioural problems. In order to improve correspondence of these scales with clinical diagnostic categories, DSM-IV scales for YSR/CBCL problem behaviours were created by Achenbach et al.[42] From these Achenbach DSM-IV scales we used the Affective Problems scale to measure depressive problems. Higher scores indicated more depressive problems.

Functioning

Academic performance. Academic performance (see Appendix 1) was measured using a teacher questionnaire, developed for TRAILS. This questionnaire contains four (T1) or eight (T2 and T3) items on work pace, effort, and achievement. The difference in the number of items that are assessed at T1 and T2/T3 is due to the difference in subjects that are taught at primary versus secondary school (i.e., language and mathematics at T1 and language, mathematics, geography, history, chemistry, biology, etc. at T2/T3). The derived academic performance variable had an internal consistency of α 0.85 for T1, α 0.87 for T2, and α 0.86 for T3. Lower scores represented poor academic performance whereas higher scores represented better academic performance. The teachers who reported academic performance differed over the three waves. In primary school (T1), academic performance was reported by the full-time teacher of the class the participant was in. In secondary school (T2 and T3), academic performance was reported by the mentor. This mentor is a teacher who is responsible for, and has good insight into, the students' academic progress. Nonetheless, the teacher in primary school may in general have a better view over the child than the teacher in secondary school who only sees the participant a few hours per week. Correspondingly, in primary school more teachers completed the teacher questionnaire (response rate 86%) than in secondary school, where more questionnaires were missing (response rate 70% at T2 and 42% at T3).

Social well-being

Information on social well-being (see Appendix 2) of the adolescent at school was measured using a self-reported measure based on the Social Production Functions Theory[43,44] This measure contains 8 items on how adolescents perceived to be regarded by classmates (e.g., "Most classmates like being with me", "Most classmates help me if needed"). The items were rated on a 5-point Likert scale (never–always, T1=α 0.91; T2=α 0.89; T3= α 0.87) and higher scores indicated more social well-being.[45]

Social problems

The Social Problem scale (see Appendix 3) is an empirically developed scale and is derived from the earlier described parent-reported CBCL questionnaire. It contains 11 items on problems with regard to social relations with others (peers, adults) and motor difficulties that are associated with poor social functioning (e.g., being clumsy, speech problems). The scale had an internal consistency of α 0.78 at T1 and α 0.76 at T2 and T3. A higher score corresponded to more social problems, a lower score to less social problems.

Statistical analysis

Descriptive statistics and correlations were calculated using PASW Statistics 18. To examine the longitudinal relationship between depressive problems and functioning, path analyses with cross-lagged effects were conducted by means of structural equation modelling, using Mplus Version 5. This path model takes into account the stability of depressive problems and functioning over time, and the within-wave correlations between these variables. In addition, bidirectional effects between the study variables over time were tested. Multi-group analyses were used to test whether gender differences in the models were present. Furthermore, the analyses were done for each measure of functional problems independently (i.e., academic performance, social well-being, and social problems).

The first step in the analyses was to examine an unconstrained model that included stability paths of depressive problems and the functional problem under study, as well as within-wave correlations (Model 1). Within-wave correlations at T1 reflect cross-sectional correlations, while it reflects correlated change at T2 and T3. In subsequent models we added hypothesised cross-lagged paths to this model. In Model 2, cross-lagged paths from depressive problems to functional problems were added. This was followed by cross-lagged paths from functional problems to depressive problems (Model 3) and bidirectional paths in Model 4. Finally, by adding equality constraints over time we tested whether it was possible to fix the stability paths between adjacent waves, within-wave correlations and cross-lagged paths in one direction (Model 5); to fix different paths to be equal across gender (Model 6), and across both time and gender (Model 7), without significantly impairing the model fit. Within the time constraints, the path between depressive problems from T1 to T2 was

set equal to the path between depressive problems from T2 to T3; functioning from T1 to T2 was set equal to the path from T2 to T3; within-wave correlations at T2 were set equal to that at T3; and cross-lagged paths in the same direction were set equal. If adding time constraints (Model 5) significantly impaired model fit, we kept the best unconstrained model. If adding gender constraints (Model 6) significantly impaired model fit, we analysed models 1 to 5 for girls and boys individually and kept either the best unconstrained or time-constrained model.

To determine the goodness-of-fit of the models, the following global fit measures were used: Chi-Square/degrees of freedom ($\chi 2/df$) ratio, Comparative Fit Index (CFI), Tucker-Lewis Fit Index (TLI), and the Root Mean Square Error of Approximation (RMSEA). We assume a model to show good fit when the $\chi 2/df$ ratio is less than 3, the CFI/TLI is larger than .95, and the RSMEA is smaller than .08.[46] We selected the model that fitted the data best and that was the most parsimonious model. Model comparisons were conducted using robust $\chi 2$ difference tests.[47] A significant robust $\chi 2$ difference test indicated that the more complex model showed better model fit than the parsimonious model, i.e. with model 1-4 this implicates that adding paths to the model improved model fit. In model 5-7, a significant robust $\chi 2$ difference test indicated that adding equality constraints significantly impaired the model fit as adding constraints makes the model more parsimonious. Relatively higher CFI/TLI's and lower RMSEA's indicated a better model fit.

Little's Missing Completely At Random (MCAR) Test produced a normed $\chi 2$ ($\chi 2/df$) of 1.21, which indicates that it is likely that data were missing at random and it is safe to impute missing values.[48,49] Missing values of the 2230 baseline participants were estimated in Mplus using Full Information Maximum Likelihood (FIML).[50] The FIML approach computes a case wise likelihood function using only those variables that are observed for case *i*. Hence, the FIML approach does not impute missing values, although direct estimation of model parameters and standard errors using all available raw data is conceptually equivalent to replacing missing data points.[51,52] In addition, we used Robust Maximum Likelihood Estimation to take into account the non-normal distribution of the depressive problems data.[51]

Results

Descriptive statistics of the study population are given in Table 1. Repeated measures ANOVA indicated that there were significant changes in all variables over time (depressive problems $F(1.87, 3265.79) = 13.24$, $p = <.001$, $\eta = .008$; academic performance $F(1.96, 1184.76) = 58.10$, $p = <.001$, $\eta = .09$; social well-being $F(1.92, 3072.20) = 1.42$, $p = .001$, $\eta = .001$; social problems $F(1.87, 2623.30) = 269.49$, $p = <.001$, $\eta = .16$)). Furthermore, the change in depressive symptoms and social problems differed slightly between girls and boys (depressive problems $F(1.89, 3286.97) = 39.81$, $p = <.001$, $\eta = .02$;

academic performance F(1.96, 1182.89) = .51, p = .60, η = .001; social well-being F(1.92, 3069.93) = .43, p = .64, η = .000; social problems F(1.87, 2620.72) = 7.59, p = .001, η = .005). The bivariate correlations (Table 2) showed that among the three measures of functioning social problems were highest correlated with depressive problems. Academic performance and social well-being showed weak negative correlations with depressive problems.

Table 1. Descriptive statistics of the study population

			Total		Girls		Boys	
Variable	***Respondent***	***Time***	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Depressive problems	Combined	1	.24	.19	.25	.19	.24	.19
		2	.22	.20	.25	.22	.19	.18
		3	.24	.23	.28	.25	.19	.19
	Child	1	.29	.25	.30	.25	.28	.25
		2	.27	.26	.32	.29	.22	.22
		3	.30	.27	.36	.30	.22	.22
	Parent	1	.19	.20	.18	.19	.20	.20
		2	.15	.19	.15	.19	.15	.19
		3	.16	.21	.17	.22	.14	.18
Academic performance	Teacher	1	3.57	.91	3.71	.85	3.42	.95
		2	3.27	.78	3.42	.77	3.13	.77
		3	3.19	.77	3.36	.72	3.02	.78
Social well-being	Child	1	3.58	.73	3.66	.72	3.50	.73
		2	3.59	.65	3.68	.55	3.48	.65
		3	3.57	.56	3.64	.55	3.50	.56
Social problems	Parent	1	.28	.28	.27	.27	.30	.28
		2	.17	.22	.16	.21	.19	.24
		3	.15	.21	.15	.21	.15	.20

Model comparisons

All multi-group analyses (Model 6) showed that fixing stability paths, within-wave correlations, and cross-lagged paths across gender significantly impaired model fit (information available on request). This indicates that there were gender differences in the relationship between depressive problems and the three types of functioning. Hence, the best fitting models of combined depressive problems and the functioning measures under study are provided for girls and boys separately, including their standardised path coefficients (Table 3; Figure 1-3).

Depressive problems and academic performance

In both girls and boys, all models (Model 1-4) showed considerable stability in depressive problems and academic performance over time, particularly between two subsequent measurements. In addition, higher levels of depressive problems were correlated with less academic performance (i.e., within-wave correlation T1), and a relative increase in depressive problems was associated with a relative decrease in academic performance (i.e., correlated change at T2 and T3). In girls only, depressive problems were predictive of a decrease in academic performance over time whereas higher academic performance was related to a decrease in later depressive problems (Figure 1). Lastly, no cross-lagged effects between depressive problems and academic performance were found in boys (Figure 1).

Adding time constraints to the models did not significantly decrease model fit, and thus the constrained paths were of similar strength over time.

Depressive problems and social well-being

With regard to social well-being, the models (Model 1-4) showed stability in depressive problems and social well-being over time. In both girls and boys, higher levels of depressive problems were correlated with lower social well-being (i.e., within-wave correlations T1) and change in depressive problems was associated with change in social well-being (i.e., correlated change at T2 and T3). In addition, depressive problems predicted a later decline in social well-being in both girls and boys. In contrast, social problems did not predict an increase in later depressive problems (Figure 2). Adding time constraints did not weaken model fit in all models, indicating that the stability, within-wave, and cross-lagged paths were equal over time.

Depressive problems and social problems

Depressive problems and social problems appeared stable over time, and depressive problems were associated with more social problems (i.e., within-wave correlations T1) while an increase in depressive problems was correlated to an increase in social problems at T2 and T3. In addition, there were clear relations between depressive problems and social problems over time (Figure 3). Both girls' and boys' depressive problems predicted later social problems while social problems predicted later depressive problems. Finally, all paths appeared to be equal over time as adding time constraints did not significantly deteriorated the models.

Table 2. Bivariate correlations between all study variables

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1. T1 depressive problems	1.000											
2. T2 depressive problems	.550**											
3. T3 depressive problems	.413**	.586**										
4. T1 academic performance	-.124**	-.072**	.077**									
5. T2 academic performance	.065*	-.108**	-.106**	.281**								
6. T3 academic performance	.059	-.055	-.033	.182**	.314**							
7. T1 social well-being	-.209**	-.137**	-.084**	.038	-.003	-.033						
8. T2 social well-being	-.187**	.253**	-.161**	.124**	.133**	.024	.354**					
9. T3 social well-being	-.124**	-.178**	-.221**	-.075**	.097**	.040	.251**	.367**				
10. T1 social problems	.491**	.340**	.290**	-.235**	-.085**	-.004	-.184**	-.211**	-.119**			
11. T2 social problems	.344**	.469**	.329**	-.191**	.096**	-.015	-.116**	-.248**	-.140**	.640**		
12. T3 social problems	.278**	.348**	.501**	-.154**	-.093**	-.062	-.127**	-.194**	-.161**	.531**	.616**	1.000

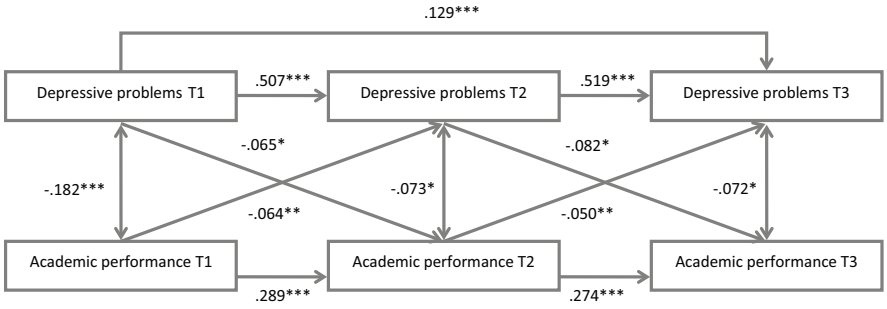
Table 3. Longitudinal model fit indices and model comparison tests with academic performance, social well-being, and social separately for girls and boys (N=2230; 1132 girls and 1098 boys)

GIRLS											BOYS									
M	*df*	MLr χ^2	χ^2/df	SCF	CFI	TLI	RMSEA		$\Delta\chi^2$	Δdf	*p*	M	*df*	MLr χ^2	χ^2/df	SCF	CFI	TLI	RMSEA		$\Delta\chi^2$	Δdf	*p*
ACADEMIC PERFORMANCE																							
1.	6	24.627	4.105	1.008	0.973	0.936	0.052					1.*	6	11.213	1.869	1.001	0.993	0.984	0.028				
2.	4	17.821	4.455	1.009	0.980	0.929	0.055	2 vs. 1	6.802	2	.033	2.	4	9.713	2.428	0.951	0.993	0.974	0.036	2 vs. 1	1.805	2	.406
3.	4	14.571	3.643	1.002	0.984	0.946	0.048	3 vs. 1	10.023	2	.007	3.	4	9.617	2.404	0.982	0.993	0.975	0.036	3 vs. 1	1.714	2	.425
4.*	2	7.692	3.846	0.998	0.992	0.941	0.050	4 vs. 1	16.927	4	.002	4.	2	8.651	4.326	0.864	0.991	0.940	0.055	4 vs. 1	3.506	4	.477
								4 vs. 2	10.103	2	.006									4 vs. 2	1.698	2	.428
								4 vs. 3	6.882	2	.032									4 vs. 3	1.790	2	.409
5.	7	12.774	1.825	1.161	0.992	0.983	0.027	4 vs. 5	5.834	5	.323	5.	9	11.589	1.288	1.111	0.997	0.995	0.016	1 vs. 5	1.241	3	.743
SOCIAL WELL-BEING																							
1.	6	42.345	7.058	1.093	0.960	0.906	0.073					1.	6	19.987	3.331	1.088	0.984	0.962	0.046				
2.*	4	5.712	1.428	0.992	0.998	0.993	0.019	2 vs. 1	31.364	2	<.001	2.*	4	5.987	1.497	1.056	0.998	0.992	0.021	2 vs. 1	13.389	2	.001
3.	4	35.359	8.840	1.132	0.965	0.879	0.083	3 vs. 1	6.164	2	.046	3.	4	14.178	3.545	1.075	0.988	0.958	0.048	3 vs. 1	5.839	2	.054
4.	2	0.515	0.258	0.974	1.000	1.011	0.000	4 vs. 1	39.724	4	<.001	4.	2	0.396	0.198	1.003	1.000	1.013	0.000	4 vs. 1	18.884	4	<.001
								4 vs. 2	5.114	2	.078									4 vs. 2	5.343	2	.069
								4 vs. 3	30.639	2	<.001									4 vs. 3	12.942	2	.002
5.*	8	10.485	1.311	1.199	0.997	0.995	0.017	2 vs. 5	4.911	4	.297	5.	8	11.585	1.448	1.265	0.996	0.993	0.020	2 vs. 5	5.653	4	.227
SOCIAL PROBLEMS																							
1.	6	36.138	6.023	1.373	0.975	0.941	0.067					1.	6	39.164	6.527	1.267	0.974	0.939	0.071				
2.	4	23.345	5.836	1.288	0.984	0.943	0.065	2 vs. 1	12.670	2	.002	2.	4	27.321	6.830	1.160	0.982	0.935	0.073	2 vs. 1	12.106	2	.002
3.	4	9.934	2.484	1.420	0.995	0.982	0.036	3 vs. 1	27.765	2	<.001	3.	4	11.378	2.845	1.308	0.994	0.980	0.041	3 vs. 1	29.315	2	<.001
4.*	2	2.062	1.031	1.315	1.000	1.000	0.005	4 vs. 1	33.457	4	<.001	4.*	2	3.170	1.585	1.158	0.999	0.994	0.023	4 vs. 1	34.771	4	<.001
								4 vs. 2	21.695	2	<.001									4 vs. 2	24.115	2	<.001
								4 vs. 3	7.472	2	.024									4 vs. 3	7.690	2	.021
5.	7	8.140	1.163	1.604	0.999	0.998	0.012	4 vs. 5	6.016	4	.198	5.	7	7.243	1.035	1.548	1.000	1.000	0.006	4 vs. 5	4.426	5	.499

* Best unconstrained model

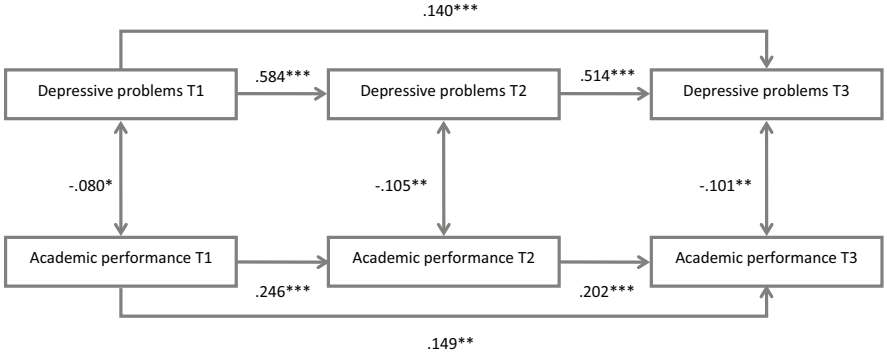
Models (in accordance with the description in the method section):
1. Unconstrained model with stability paths and within-wave correlations
2. M1 and cross-lagged paths from depressive problems to functioning
3. M1 and cross-lagged paths from functioning to depressive problems
4. M1 and bidirectional paths between depressive problems and functioning
5. Best model (from step 1 to 4) with equality constraints over time

GIRLS



MLr χ^2=12.774, df=7, CFI=.992, TLI=.983, RMSEA=.027 + Equality Constraints (time). N=1132.

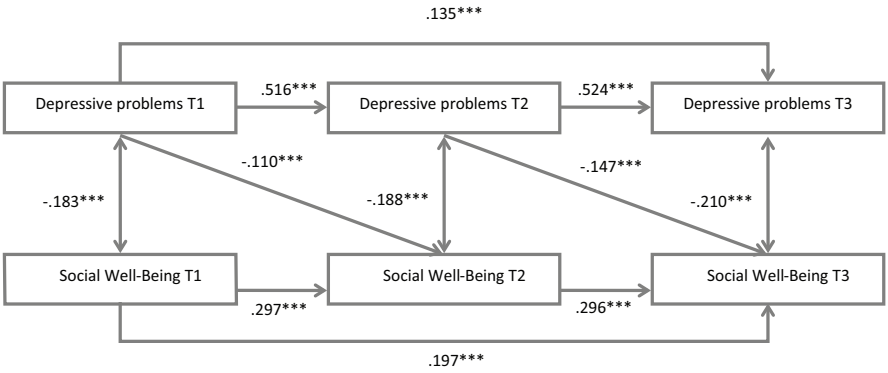
BOYS



MLr χ^2=11.589, df=9, CFI=.997, TLI=.995, RMSEA=.016 + Equality Constraints (time). N=1098.

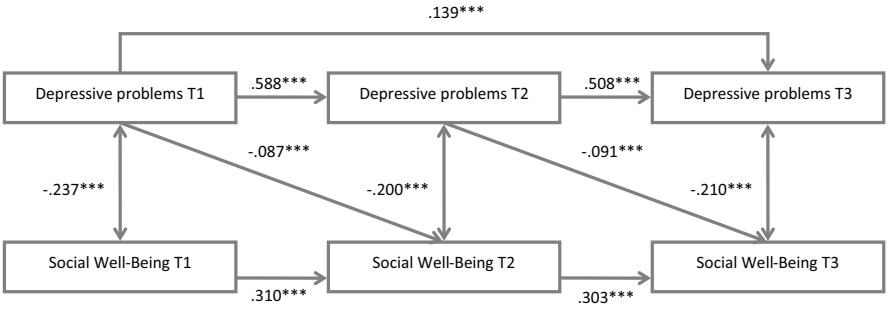
Figure 1. Longitudinal associations between depressive problems and academic performance for girls and boys (models with best model fit)

GIRLS



MLr χ^2=10.485, df=8, CFI=.997, TLI=.995, RMSEA=.017 + Equality Constraints (time). N=1132.

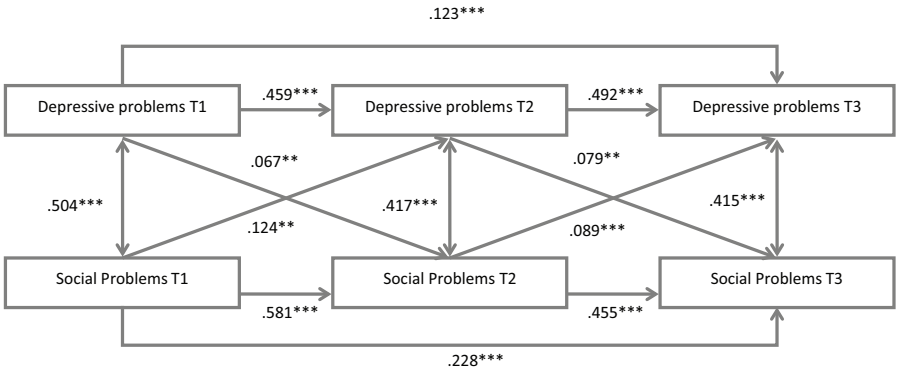
BOYS



MLr χ^2=11.585, df=8, CFI=.996, TLI=.993, RMSEA=.020 + Equality Constraints (time). N=1098.

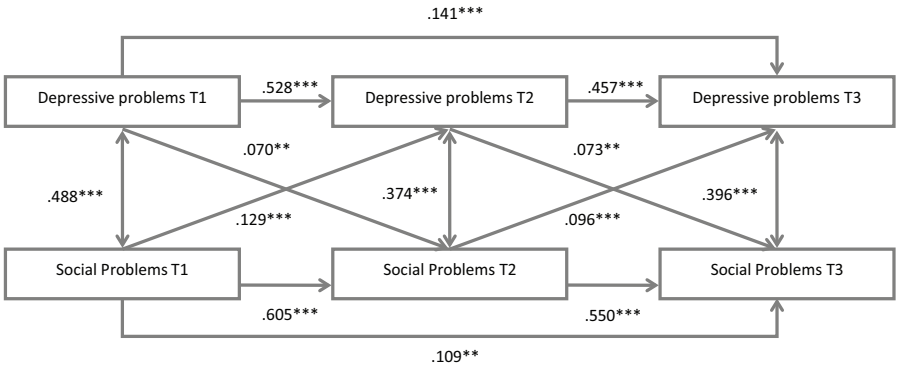
Figure 2. Longitudinal associations between depressive problems and social well-being for girls and boys (models with best model fit)

GIRLS



MLr χ^2=8.140, df=7, CFI=.999, TLI=.998, RMSEA=.012 + Equality Constraints (time). N=1132.

BOYS



MLr χ2=7.243, df=7, CFI=1.000, TLI=1.000, RMSEA=.006 + Equality Constraints (time). N=1098.

Figure 3. Longitudinal associations between depressive problems and social problems for girls and boys (models with best model fit).

Discussion

In the present study we aimed to gain more insight into the longitudinal relationship between depressive problems and academic performance, social well-being, and social problems of adolescents from the general population. Our analyses yielded four important findings. First, there is sizable stability in depressive and functional problems over time and there are clear within-wave correlations between depressive problems and the three types of functioning. Second, poor social well-being precedes depressive problems, but the contrary association was not found. Third, the relationship between depressive problems and social problems is bidirectional: Depressive problems were associated with later social problems and social problems were associated with later depressive problems. Finally, depressive problems and academic performance are bidirectionally related to each other, but only in girls.

Of the theoretical frameworks that we described in this study, the ICF model seems applicable to all our measures of functioning. To recapitulate, the ICF model views poor functioning as a result of disease-related physical of mental impairments such as depression.[9] Our results showed that functioning in all domains deteriorated due to depressive problems. The only exception was academic performance in boys which was not affected by depressive problems. The competency-based model of depression asserts that adolescents' poor functioning leads to negative feedback from others, which triggers a negative self-perception of the adolescent and can subsequently cause depression.[8] This theory was applicable to academic performance and social problems, but not to social well-being. This seems plausible as academic performance and social problems were reported by others and represent actual problems in either academic or social functioning. Hence, poor functioning in this regard increases the chance of negative feedback towards the adolescent. This negative feedback may be adopted by the adolescent and can trigger depression. Social well-being is a self-reported measure of perceived social well-being and a low score on this does not necessarily mean that others will also perceive and criticise the adolescent as poorly functioning.

The bidirectional cross-lagged relation that we found between depressive problems and poor academic performance in girls is largely in line with our hypotheses. As we expected, poor academic performance precede more depressive problems. From a theoretical point of view, this is plausible. Poor academic performance is likely to lead to negative feedback from parents, classmates, teachers, and others. In line with the competency-based model of depression, this negative feedback may initiate negative self-perception of the adolescent, which can subsequently trigger depressive problems.

The path from depressive problems and poor academic performance was hypothesised to be weaker, since this path was scarcely supported by the literature.[2,25] Nonetheless, we did find that poor academic performance is prospectively associated with more depressive problems. This pathway is supported by the ICF model, which suggests a negative effect of depressive problems on academic performance. Furthermore, it is plausible that depressive

problems affect academic performance in some way. That is, depressed children are more often absent from school, show more days with impairment, and do not participate as actively as non-depressed children do.[2,4,36,53] In addition, depressive thoughts may distract from schoolwork. Combined, these negative effects of depressive problems may lead to a decline in school results and overall poor academic performance.

Although we expected the relation between depressive problems and academic performance to be smaller in boys than in girls, it is surprising that we did not find any cross-lagged effects in boys at all. This is in line with previous research.[5] It is possible that academic performance in boys, compared to girls, is more associated with externalising problems than internalising, depressive problems.[27] It may thus be that different types of psychopathology are associated with academic performance in boys and girls.

In line with the ICF model, depressive problems directly influenced poor social well-being in this study. Additionally, previous studies support this finding. Adolescents with depressive problems are found to engage more in excessive and negative feedback seeking and thus experience interpersonal relationships in a negative way, which results in low perceived social well-being.[26] This low social well-being may not always be realistic and biased by depressive thoughts. Furthermore, adolescents with depressive problems are on average less involved in organised activities compared to healthy adolescents, which may negatively influence the status in their social network.[53]

In line with our hypothesis, we did not find support for a path from low social well-being to more depressive problems. As described above, the competency-based model of depression may indeed not directly be applicable to the social well-being measure as social well-being is a self-reported measure and does not reflect the opinion of others. Previous studies reported mixed results with regard to this relation.[5,28] Although the within-wave correlations suggest there is a bidirectional effect between the two, self-perceived social well-being was not associated with prospective depressive problems over time. Differences between boys and girls were only minor, but the standardised path coefficients for girls were slightly stronger, indicating that depressive problems affect social well-being over time in girls more than in boys.

As hypothesised, depressive problems were associated with prospective social problems and social problems were associated with prospective depressive problems. This bidirectional effect has, to our knowledge, not been studied before but unidirectional effects in both directions were found in previous studies.[3,7,28,29] Groeben et al.[28] linked the path from social problems to depressive problems to the competency-based model of depression like we did. That is, negative feedback on social skills may be internalised by the adolescent, leading to depressive problems. Also, in line with the explanation we gave with regard to social well-being, depressive problems may lead to less social activity which subsequently may lead to a decline in social skills resulting in more social problems. Other underlying factors that may explain the path from social problems to depressive problems are the motor difficulties

that are taken into account in the social problems measure. These motor difficulties, such as clumsiness, were previously shown to increase proneness to victimisation in adolescence. In addition, children with poor motoric skills are likely to receive less positive and social feedback and recognition from peers as compared to children with normal motoric abilities.[54] Both proneness to victimisation and negative social feedback can trigger depressive problems.

The relation between depressive problems and social problems differed significantly between boys and girls, which was most visible in the stability of long-term social problems. In girls, the association between social problems at T1 and T3 is stronger than in boys, indicating that social problems remain more constant over time in girls than in boys.

Limitations, strengths, and implications of the study

The current findings should be interpreted against the backdrop of some limitations. First, the measures of adolescents' functioning that were used in this study reflect important domains of functioning in adolescence but do not cover all relevant domains. Hence, we can only draw conclusions on the specific types of functioning that we have taken into account. Second, depressive problems were measured using the CBCL/YSR questionnaires. The scales that are derived from these questionnaires are not in accordance with the DSM-IV criteria so the scales had to be reconstructed afterwards to improve correspondence with the clinical diagnostic categories. As a result, the items are not one-to-one equal to all DSM-IV criteria, and inferences about DSM-IV major depressive disorder cannot be made. Third, as in all longitudinal studies, we had to cope with missing data due to attrition. We tried to address this issue by using full information maximum likelihood estimation. Strengths of this study include the large representative sample and the advanced longitudinal data analysis strategy to estimate bidirectional prospective effects. Also, we tested bidirectional cross-lagged effects between depressive problems and multiple types of functioning in adolescents for boys and girls separately, thereby extending previous research. Furthermore, we used information from multiple informants on depressive problems, academic performance, social well-being, and social problems. By combining the reports on depressive problems from child and parents we took into account the unique views from two important informants. Because it is difficult to determine whose view is most valid and accurate, we believe that if at least one informant reports depressive problems, it is useful to take this report into account as it may reflect part of the adolescent's functioning. In addition, the validity of the reports by child and parent may differ depending on the child's age.[27] Young adolescents may be less able to rate their own behaviour and compare themselves to others than older adolescents are. Consequently, child reported depressive problem scores may be less accurate at younger age than at older age. In contrast, parents may be better able to report their children's depressive problems when the adolescents are younger than when they get older and are more likely to be independent of their parents and develop their own lives.

To summarise, we assessed how depressive problems and three types of functioning in adolescents were related to each other. We conclude that depressive problems impair academic performance and social well-being over time and contribute to social problems. In addition, poor academic performance increases later depressive problems in girls and social problems increase later depressive problems in both girls and boys. Knowledge about the existence and direction of relations between depressive problems and functioning can be applied to develop interventions and preventions. Two main findings call for attention to prevent functional problems to emerge or worsen. First, children are at serious risk for poor academic performance (in girls), poor social well-being, and social problems when depressive problems are reported by either parents or the child itself. Second, children with social problems and girls with academic problems need special attention to minimize the influence on their mental health state. Consequently, interventions should target depressive problems as well as functional problems. Finally, we showed that there were gender differences in the relation between depressive problems and functioning and interventions should therefore be tailored to address the unique needs of girls and boys.

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Appendix 1.

Original items of the Teacher Questionnaire: academic performance scale.

Items are translated from Dutch into English.

1. Student has a good work pace
2. Student shows effort
3. Student does not perform in accordance with own level (reversed item)
4. Current results regarding Dutch language
5. Current results regarding foreign languages?*
6. Current results regarding maths
7. Current results regarding geography and history?*
8. Current results regarding physics, chemistry, and biology?*

* Only asked at secondary school (T2 and T3)

Appendix 2.

Original items from the Social Production Function questionnaire – social well-being scale.

Items are translated from Dutch into English.

1. Most classmates like doing something together with me.
2. Most classmates help me if needed.
3. Most classmates consider my feelings.
4. Most classmates like being with me.
5. Most classmates think I behave well.
6. Most classmates like to get my help.
7. Most classmates I can truly trust.
8. Most classmates appreciate me like I am.

Appendix 3.

Original items from the Child Behavior Checklist – Social Problems Scale.

Items are translated from Dutch into English.

1. Dependent
2. Lonely
3. Doesn’t get along
4. Jealous
5. Has the feeling that others are out to get him/her
6. Accident-prone
7. Teased
8. Unliked by other boys/girls
9. Clumsy
10. Prefers being with younger kids
11. Speech problems